Specification of Ancillary Operation

Guidelines

Roads and Traffic Authority
www.nsw.rta.gov.au

Title:	Specification of Ancillary Operation – Guidelines
Document no:	TS-TN-022
Version:	1.0
Date:	26 May 2009
Approved by:	P. Margison, General Manager Traffic Management

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Revision history

Version	Date	Details

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1 Introduction

1.1 Purpose

This document provides a description of the ancillary functions that are occasionally required to be supported by a traffic signal controller. In addition, it provides general information on how the ancillary functions operate.

In the case of the ancillary functionality the intersection designer need only notate the intersection design that it be included and any requirements for the intersection design as are specified herein, such as detector allocation or phases.

1.2 Scope

This document covers the ancillary functionality for:

- Emergency phase inclusion
- Bus priority
- Rail level crossing coordination

The above ancillary functions can be called for when designing and implementing an intersection design and its personality.

1.3 Definitions and abbreviations

Provided below are general definitions. Definitions which are particular to an ancillary function are contained in the relevant section.

Term	Meaning
PTIPS	Public Transport Information and Priority System
RTA	Roads and Traffic Authority
SCATS	Sydney Co-ordinated Adaptive Traffic System
VGMT	Vehicle Green for Maximum Time

1.4 References

[1] TS-QA-156, Personality Standard Tables Management – Standard Operating Procedure

[2] TS-TN-019, Specification of Vehicle Group Operation – Guidelines for Developing

[3] TS-TN-020, Specification of Detector Logic Operation – Guidelines for Developing

[4] TS-TN-021, Specification of Pedestrian Movement Operation – Guidelines for Developing

[5] TS-TN-023, Layout of Macros for Standard Tables – Guidelines

[6] TS-TN-026, Standard for Single Diamond Overlap Phasing

[7] TS-TN-027, Standard for Double Diamond Overlap Phasing

[8] RTA-TC-106, Traffic Signal Operation, Version 1.1, October 2000

[9] TSI-CO-001, Level Crossing Interface – Concept of Operations

[10] TSI-DG-001, Level Crossing Interface – Design Guidelines

[11] Rail Level Crossing – Traffic Light Design Interface Agreement, 09 January 2009

[12] TS-MKT-005, PTIPS – Public Transport Information and Priority System, version A, 19 March 2007

2 Emergency Service Phase Facility

2.1 Scope

These notes apply to emergency service phases for ambulance, fire and/or police vehicles, but do not apply to time critical situations such as railway level crossings (see section 4).

2.2 Demand

A push button shall be provided in the emergency service station to allow the emergency service phase to be demanded. This push button can be connected to any detector input.

A second push button shall be provided if:

a) two emergency services can demand the same emergency service phase; or

b) one emergency service can demand a choice of two different emergency service phases.

The second push button can be connected to any detector input.

The detector input(s) for the emergency service demand(s) shall be prevented from sending open circuit detector alarms to the SCATS master, the same as pedestrian push button inputs.

2.3 Operation

When a demand is registered for the emergency service phase, the controller shall immediately revert to isolated operation. The emergency service phase demand causes expiry of the maximum timer for the running phase. Thus, the running phase is terminated with the minimum delay, subject to pedestrian walk and clearance times.

If the controller is in the late start through extension green intervals when the demand for the emergency service phase is received, the controller shall move from the current phase to the emergency service phase upon expiry of the minimum green interval and the pedestrian clearances.

If the controller is in the early cut-off green through all-red intervals when the demand for the emergency service phase is received, the controller shall move to the next phase, but shall suppress the introduction of the pedestrian walks. The controller shall then terminate this phase upon expiry of the minimum green interval and move to the emergency service phase.

The emergency service phase shall be held for the duration of the maximum green time. The controller shall then move to either:

a) the next demanded phase in sequence after the emergency service phase; or

b) a specified phase; or

c) the phase that was interrupted by the emergency service demand;

whichever is specified on the design plan.

The emergency service phase is operated as a Vehicle Green for Maximum Time (VGMT) phase, i.e. the phase runs for the maximum green time.

2.4 SCATS Notification

The controller informs SCATS that a demand exists for the emergency service phase by either:

a) generating a locked demand for 'G' phase; or

b) setting a bit of the miscellaneous status word; or

c) setting bits 6 and 5 of the second system status word.

Method (a) can only be used if G phase is not used as part of the normal intersection phasing.

The notification must be automatically cleared in the all-red interval of the emergency service phase and the normal mode of operation restored.

2.5 Displays

Generally, an indicator with a red and green display shall be provided in the emergency service station. The display shall be green during the late start to early cut-off green intervals of the emergency service phase and red at all other times.

Controllers employing contactors for lamp switching shall be interlocked such that the green display on the emergency service indicator cannot be extinguished by a fault on any other signal group.

2.6 Table Entries

The following example details the tables required for emergency service control. The example assumes a simple 2 phase intersection, with pedestrian features for A and B phases. The emergency service Phase is C phase, with signal group 3 controlling the lantern in the emergency service station.

Vehicle Signal Group Colour Table

```
           FDB    RED,RED,SGAR

    CTAB3  FDB    *
           FDB    INAMB,SG3G
           FDB    SET,OFF

           FDB    INAMB
           FDB    SET,RED

           FDB    END

    VGMT   FDB    3,END                 ( C PHASE )
```

Demand Function Table

```
    FUNDEF EQU    *
    FUND3  FDB    CALLC,EXCG,END        (FIRE STATION CALL)
    FUND4  FDB    CALLG,NOCLR,END   (FLAG FIRE STATION CALL)
```

Demand Condition Table (in MISCELLANEOUS section, ie at end of CTABD Table)

```
*** FIRE STATION FEATURE
    CTABD  EQU    *
           FDB    XDET11,NFLG10         (CALL FIRE PHASE ONCE
ONLY)
           FDB    SETDEM,3
           FDB    SETDEM,4
           FDB    STOREF,10

           FDB    NXDET11           (ALLOW ANOTHER CALL WHEN
           FDB    CLEARF,10             FIRE  BUTTON DE-ACTUATES)

           FDB    FUN4              (GO ISOLATED FOR FIRE CALL)
           FDB    GOISOL
           FDB    CLRALL            (CLEAR ALL DEMANDS EXCEPT
           FDB    RSTDMS,2,3,4      FOR FIRE PHASE AND G PHASE)
```

```
          FDB     FUN4,NINC
          FDB     EXPIRE,MAXGT-RAM

          FDB     INC,RSTEXT             (SET CALL FOR A PHASE)
          FDB     SETDEM,1

          FDB     INC,INRED,NFUN3        (RESTORE DEMANDS WHEN
          FDB     RSTALL             LEAVING FIRE PHASE)
          FDB     CLRDEM,4
```

General Condition Table

This is used to control the introduction of any pedestrian movements.

```
   CTABG   EQU     *

   *       Pedestrian Movement P1

           FDB     FSINA,P1ADM,NFUN4
           FDB     GOWALK,1

   *       Pedestrian Movement P2

           FDB     FSINB,P2ADM,NFUN4
           FDB     GOWALK,2
```

General Condition Table entries for detector 8-

```
   ALWAYS
   BITCB,$E0,OSCTR11-RAM

   NXDET8
   BITCB,$4,ALARMS+1-RAM
```

2.7 Emergency Service Station Relay Group Modification

Where the control of the intersection is undertaken using relays, then following change needs to be completed. The relay group for the emergency service phase is modified to provide a two aspect green and red display for the emergency service station lantern.

The following example assumes that Relay Group 3 is used to control the lantern in the Fire Station.

```
   REMOVE 3A RELAY - NOT USED.
   ADD WIRE 3A3/5 - 3A3/6.
```

3 Priority and Transit Ways

An important ancillary function supported by a traffic signal controller has been a method for enhancing road based public transport travel speeds and travel time reliability.

Previously public transport, bus, priority has been facilitated through the provision of a dedicated bus lane at the intersection stop line and a proceed signal in advance of the main vehicular approach signals. In more recent years the provision of a dedicated bus road way has gained use – transit ways.

The hope is to provide a far wider bus priority system using technology to achieve this without impacting the road system. The Public Transport Information and Priority System (PTIPS) project is the initiative which is aiming to deliver this technology to NSW.

PTIPS, bus priority and transit ways are discussed in the following sub-sections.

3.1 PTIPS

The Public Transport Information and Priority System (PTIPS) is being developed to:

- provide priority at signalised intersections to assist in buses achieving published timetables;
- provide the ability to monitor the performance of bus services against contractual performance criteria;
- provide bus operators with the capability to track their buses in real-time, observing their progress against timetable and the receipt of operational alarms from individual buses;
- deliver real-time travel information to commuters.

PTIPS does not require any direct support from an intersection traffic signal controller other than it be connected to SCATS. Further information can be found in the PTIPS overview, [12]. The intersection designer does not have any input to this form of bus priority mechanism.

3.2 Intersection Bus Priority

There are a number of intersections where buses are provided with a dedicated short lane which is signalised to provide them with an opportunity to proceed before the main approach signals. The proceed aspect is an aspect which is a white lit letter 'B'. In some cases a full three aspect lantern is provided where the roundels are replaced with 'B' aspects and coloured red, yellow and white. A green 'B' must not be used under any circumstances.

The methods for achieving this operation are varied and are particular to a specific intersection, but more usually takes the form of:

- a separate phase for the bus; or
- an advanced start of proceed time for the bus.

Each of these requires the provision of some type of detector to provide input to the traffic signal controller when a bus is present.

The intersection designer is responsible for determining and defining the method of operation on the intersection design plan.

3.3 Liverpool – Parramatta Transit Way

Transit ways are dedicated bus roads which are required to be controlled where they connect with a normal road network intersection. This section provides an overview of the operational aspects that have been used in the Liverpool – Parramatta transit way.

At each intersection there is provided a bus phase which gives the buses the authority to proceed. The bus phase introduction is controlled in the same way as for any other intersection/phase, ie by using detectors. There are three standard intersection setups for bus priority operation on the Liverpool – Parramatta transit way. These provide for:

- single approach,
- double approach,
- double approach with cancel facility.

A number of standard logic tables have been established to assist in the standard intersection setups. The benefits of such a set of standard logic tables are significant with regard to design and the adaptive engineering required to translate that design into a controller personality. The standard logic tables are:

- Bus 1 with priority and stop line detection – standard table 199
- Bus 2 with priority and stop line detection – standard table 198
- Bus 1 and 2 with priority and stop line detection – standard table 200
- Bus 1 and 2 with priority, stop line detection and cancel facility – standard table 201

These are briefly described in the following sub-sections. Further information can be found in the 'Liverpool - Parramatta Transitway, Traffic Signal Controller Operation'.

3.3.1 Single Approach

A bus priority demand on an approach will result in the starting of a timer that will countdown to the display of green. Buses that are estimated to arrive before the end of the bus phase maximum green will increment a counter.

The bus phase will be held while the counter is non-zero up to the bus phase maximum time (including the additional Extra Time if enabled). It is important that the relevant Delay Time and Estimated Green Time settings be set accurately, since these time settings are used to estimate if a bus will arrive before the bus phase maximum green, and thus if it is counted.

3.3.2 Double Approach

A bus priority demand on an approach will result in the starting of a timer that will countdown to the display of green. A bus on the other approach that will arrive before the first bus will override the countdown to green ie the countdown is based on the bus that will arrive at the intersection first.

Buses that are estimated to arrive before the end of the bus phase maximum green will increment a counter. There is a counter for each approach.

The bus phase will be held while the counters are non-zero up to the bus phase maximum time (including the additional Extra Time if enabled). It is important that the relevant Delay Time and Estimated Green Time settings be set accurately, since these time settings are used to estimate if a bus will arrive before the bus phase maximum green, and thus if it is counted.

If the countdown is started by a bus on one approach it will increment the counter for that approach. A bus with a shorter arrival time on the other approach may reduce the countdown to green to the extent that buses on the first approach will now not arrive before the bus phase maximum green time.

In this case the counters on the first approach can be decremented or even set to zero.

It will manage priority for one bus on each approach and under certain conditions will manage multiple buses on each approach.

Due to limitations in the controller logic there is the risk that a counter incremented by a busA some distance from the intersection may be decremented by busB (or other official vehicle) closer to the intersection.

3.3.3 Cancel Facility

A bus priority demand on an approach will result in the starting of a timer that will countdown to the display of green. A bus on the other approach that will arrive before the first bus will override the countdown to green ie the countdown is based on the bus that will arrive at the intersection first.

Buses that are estimated to arrive before the end of the bus phase maximum green will increment a counter. There is a counter for each approach.

When priority is active, buses departing the cancel detectors during the bus phase will decrement the counter for the relevant approach.

The bus phase will be held while the counters are non-zero up to the bus phase maximum time (including the additional Extra Time if enabled). It is important that the relevant Delay Time and Estimated Green Time settings be set accurately, since these time settings are used to estimate if a bus will arrive before the bus phase maximum green, and thus if it is counted.

If the countdown is started by a bus on one approach it will increment the counter for that approach. A bus with a shorter arrival time on the other approach may reduce the countdown to green to the extent that buses on the first approach will now not arrive before the bus phase maximum green time.

In this case the counters on the first approach can be decremented or even set to zero.

It will manage priority for one bus on each approach and under certain conditions will manage multiple buses on each approach.

Due to limitation in the controller logic there is the risk that a counter incremented by a busA some distance from the intersection may be decremented by busB (or other official vehicle) closer to the intersection.

4 Rail Level Crossing

If a traffic signal installation is located close to a railway level crossing, special provision should be made to reduce the likelihood that queues generated by the traffic signals will not extend across the railway tracks. This may be achieved by treatments such as warning signs, escape routes, additional road widening and queue detectors.

Figure 1 below illustrates the general situation for a rail level crossing and road intersection layout. There are a number of factors which drive specific concerns on how a rail level crossing and road intersection may be required to operate. Examples are:

- Types of vehicle using the intersection and crossing;
- General speed of transition;
- Separation between the crossing and the intersection;

These translate into the following problems:

- Traffic can queue from the intersection stop-line back towards/over the level crossing.
- Traffic can queue from the crossing stop-line back towards/over the intersection.
- There may be cases where slow moving long vehicle traffic from the South has started to move North and the crossing starts to operate in front of them. This long vehicle could then compromise the intersection if it has to stop before the crossing. This could theoretically also happen for vehicles turning right from the East.

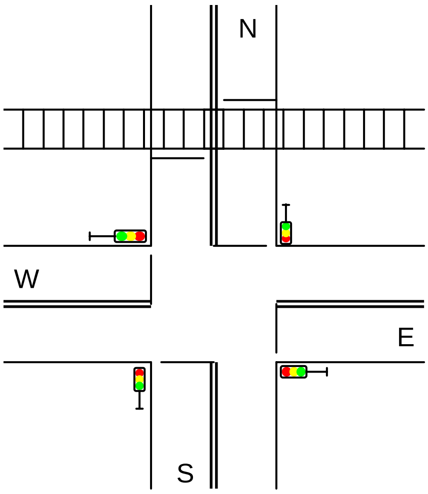

Figure 1 Example situation for rail – road interface

To alleviate the occurrences of these problems it may be suitable to coordinate the operation of the crossing and traffic signals. If traffic signal coordination with the railway level crossing is justified, indications should be provided by the Rail Authority to enable certain actions by the intersection controller.

- A special queue-clearing sequence to be initiated at a predetermined time before the train is due at the crossing.
- Once the queue-clearing phase has terminated, no phases or turning movements which would cross the railway line can be introduced until the train has cleared the crossing.

In some situations, it may be possible to include the railway level crossing within the vehicular conflict area. In this case, the train movement may be treated as a priority phase with all other traffic stopped.

The Concept of Operations [9] outlines the interface operational functionality between the rail level crossing and the traffic signal controller. Further information can be found in Design Guidelines [10].

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July 2009